the InP substrate **81** is flipped in the vertical direction on the drawing. In the present embodiment, therefore, only a Ti/Pd/Au electrode (second electrode) **811** provided on a passivation layer **805** constitutes a collector section. Due to the characteristics of the interface between Ti and InGaAs, the Ti/Pd/Au electrode **811** operates as a Schottky collector. Other specifics of the present embodiment are the same as those of the seventh embodiment.

[0069] That is, a Ti/Pd/Au electrode (first electrode) **801**, an 8-nanometer-thick InAlAs-potential barrier **802**, a 100-nanometer-thick n-InGaAs layer **804** having an electron density of 1×10^{19} cm^{-3}, and a 60-nanometer-thick i-InGaAs travel section **803** are provided. In FIG. **8**B illustrating the band profile of a semiconductor part of the present embodiment, the band profile being calculated with the Poisson solver, an electron flying within the i-InGaAs-travel section **803** travels toward the left side.

[0070] The operation method of the present embodiment is the same as that of the seventh embodiment, and a voltage source **820** applies a voltage to the gap between the electrodes **801** and **811**. However, since femtosecond-pulse light **831** emitted from a laser device **830** passes through the InP substrate **81**, the InP substrate **81** is provided as a semi-insulating substrate making the loss and/or the scattering of excitation light **831** of 1.5 μm band relatively small. In the present embodiment, a radiation pattern is controlled with the electrodes **801** and **811**, which function as an antenna, and a dielectric lens **840** provided on the antenna, that is, the electrodes **801** and **811**. Since the dielectric lens **840** includes an Si lens in the present embodiment, a terahertz wave is emitted upward as well.

Ninth Embodiment

[0071] FIG. **9** illustrates a terahertz-time-domain spectroscopic system (THz-TDS) including an electromagnetic-wave generation device according to a ninth embodiment of the present invention. The above-described spectroscopic system itself is basically the same as a known spectroscopic system. The above-described spectroscopic system includes a short-pulse laser **830**, a half mirror **910**, a light-delay system **920**, an electromagnetic-wave generation element (electromagnetic-wave generation device) **800**, and an electromagnetic-wave detection element (electromagnetic-wave detection device) **940** as main elements. The electromagnetic-wave generation element **800** and the electromagnetic-wave detection element **940** are irradiated with individual pump light **931** and probe light **932**.

[0072] A terahertz wave emitted from the electromagnetic-wave generation element **800** to which a voltage is applied from a voltage source **820** is guided to a sample **950** with terahertz guides **933** and **935**. A terahertz wave including information about, for example, the absorption spectrum of the sample **950** is guided with terahertz guides **934** and **936**, and is detected with the electromagnetic-wave detection element **940**. At that time, the value of a detected current of an ammeter **960** is proportional to the amplitude of the terahertz wave. For performing the time resolution (that is, acquiring the time waveform of an electromagnetic wave), the timing when irradiation of the pump light **931** and the probe light **932** is performed may be controlled by, for example, moving the light delay system **920** changing an optical-path length obtained on the probe light **932**-side. That is, a delay time between the time when an electromagnetic wave is generated with the electromagnetic-wave generation element **800** and the time when an electromagnetic wave is detected with the electromagnetic-wave detection element **960** is adjusted.

[0073] In the present embodiment, a photoconductive element including a low temperature-grown InGaAs layer provided for the 1.5 μm band is used as the electromagnetic-wave detection element **940**. When a secondary harmonic generator (SHG crystal) is inserted on the probe light **932**-side and the photoconductive element including the low temperature-grown InGaAs layer is used as the electromagnetic-wave detection element **940**, the signal-noise ratio is increased even though the number of components is increased as well. Thus, it becomes possible to provide a terahertz-time-domain spectroscopic system including an electromagnetic-wave generation device according to an embodiment of the present invention.

[0074] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0075] This application claims the benefit of Japanese Patent Application No. 2010-041134 filed on Feb. 26, 2010, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An electromagnetic-wave generation device comprising:

an emitter section including a first electrode;

a collector section including a second electrode;

a carrier-travel section placed between the emitter section and the collector section;

a voltage-application unit configured to apply a voltage so that a potential of the second electrode becomes higher than a potential of the first electrode; and

a light-irradiation unit configured to radiate light,

wherein the carrier-travel section includes a first semiconductor extending along a direction in which an electron carrier travels, and

wherein the emitter section includes a second semiconductor that is formed in contact with the first semiconductor, and that achieves a potential barrier, and is configured so that the carrier goes beyond the potential barrier and is emitted to the carrier-travel section only when being irradiated with the light.

2. An electromagnetic-wave generation device comprising:

an emitter section including a first electrode;

a collector section including a second electrode;

a carrier-travel section placed between the emitter section and the collector section;

a voltage-application unit configured to apply a voltage so that a potential of the second electrode becomes lower than a potential of the first electrode; and

a light-irradiation unit configured to radiate light,

wherein the carrier-travel section includes a first semiconductor extending along a direction in which a hole carrier travels, and

wherein the emitter section includes a second semiconductor that is formed in contact with the first semiconductor, and that achieves a potential barrier, and is configured so that the carrier goes beyond the potential barrier and is emitted to the carrier-travel section only when being irradiated with the light.